

A Serendipitous IXPE View of the Eclipsing Neutron Star Binary AX J1745.6-2901

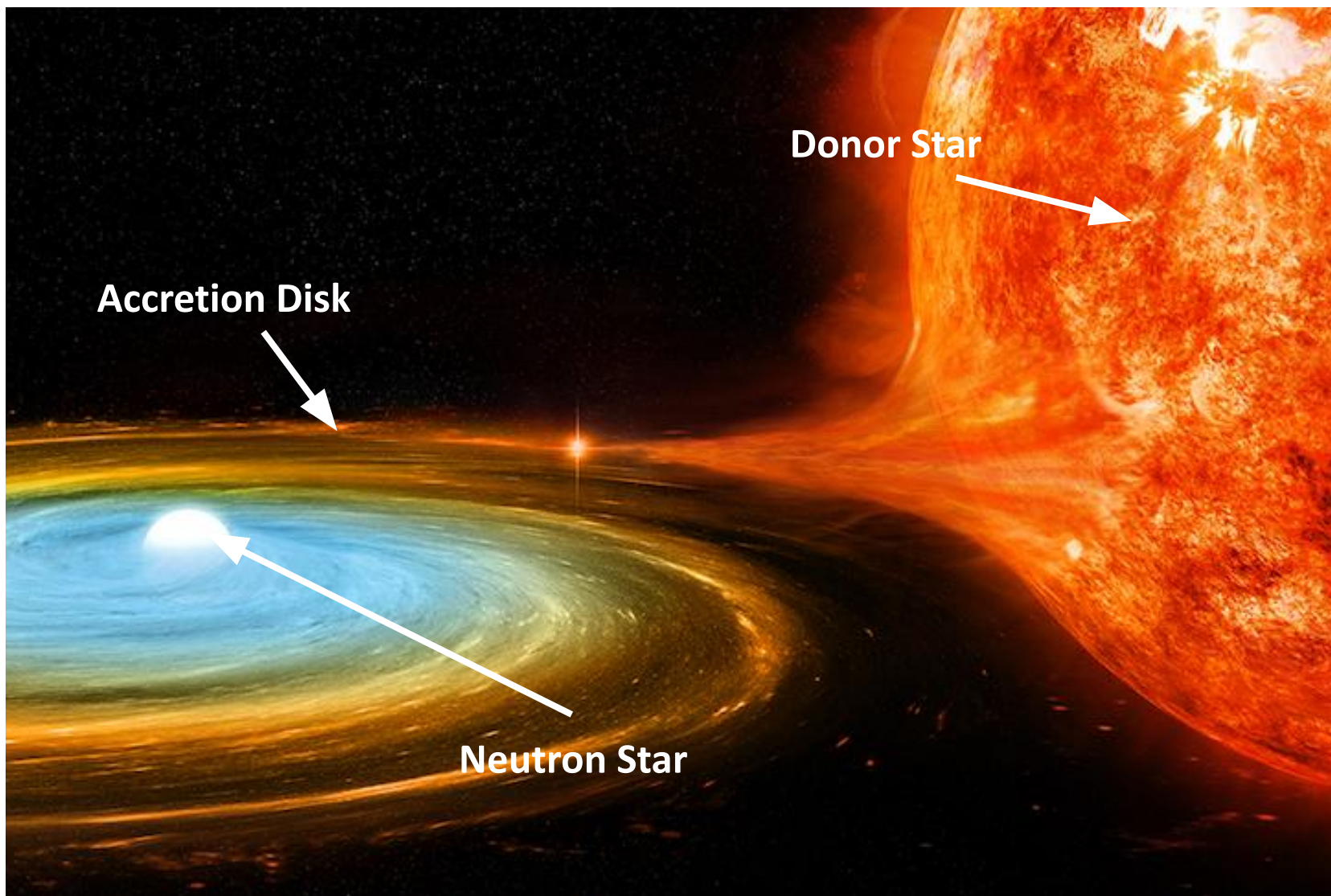
Romana Mikušincová
(INAF – IAPS Rome)

L. Marra, H. Manikantan, S. Bianchi, F. Capitanio, S. Chakraborty, R. Ciancarella, E. Costa, N. De Angelis, M. Del Santo, S. Fabiani, R. Ferrazzoli, V. E. Gianolli, A. Gnarini, A. Ingram, S. Mandel, G. Mastroserio, G. Matt, K. Mori, F. Muleri, S. Pagliarella, M. Parra, P.O. Petrucci, J. Podgorný, J. Poutanen, S. Ravi, P. Soffitta, J. F. Steiner, A. Tarana, R. Taverna, F. Ursini, A. Veledina, F. M. Vincentelli, A. Yilmaz, B. De Marco, M. Gupta, V. Loktev, T. D. Russell, J. Svoboda, F. Tombesi, S. Zhang

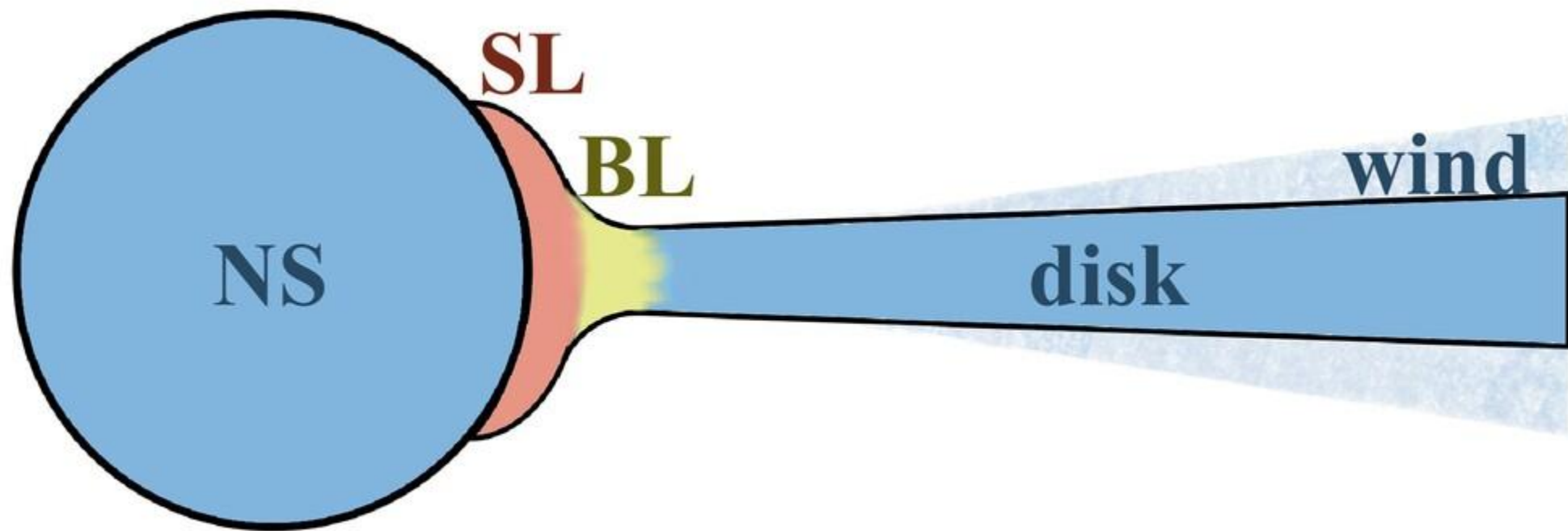
The many tones of accretion - to the memory
of Tomaso Belloni

September 10, 2026 | Cefalù

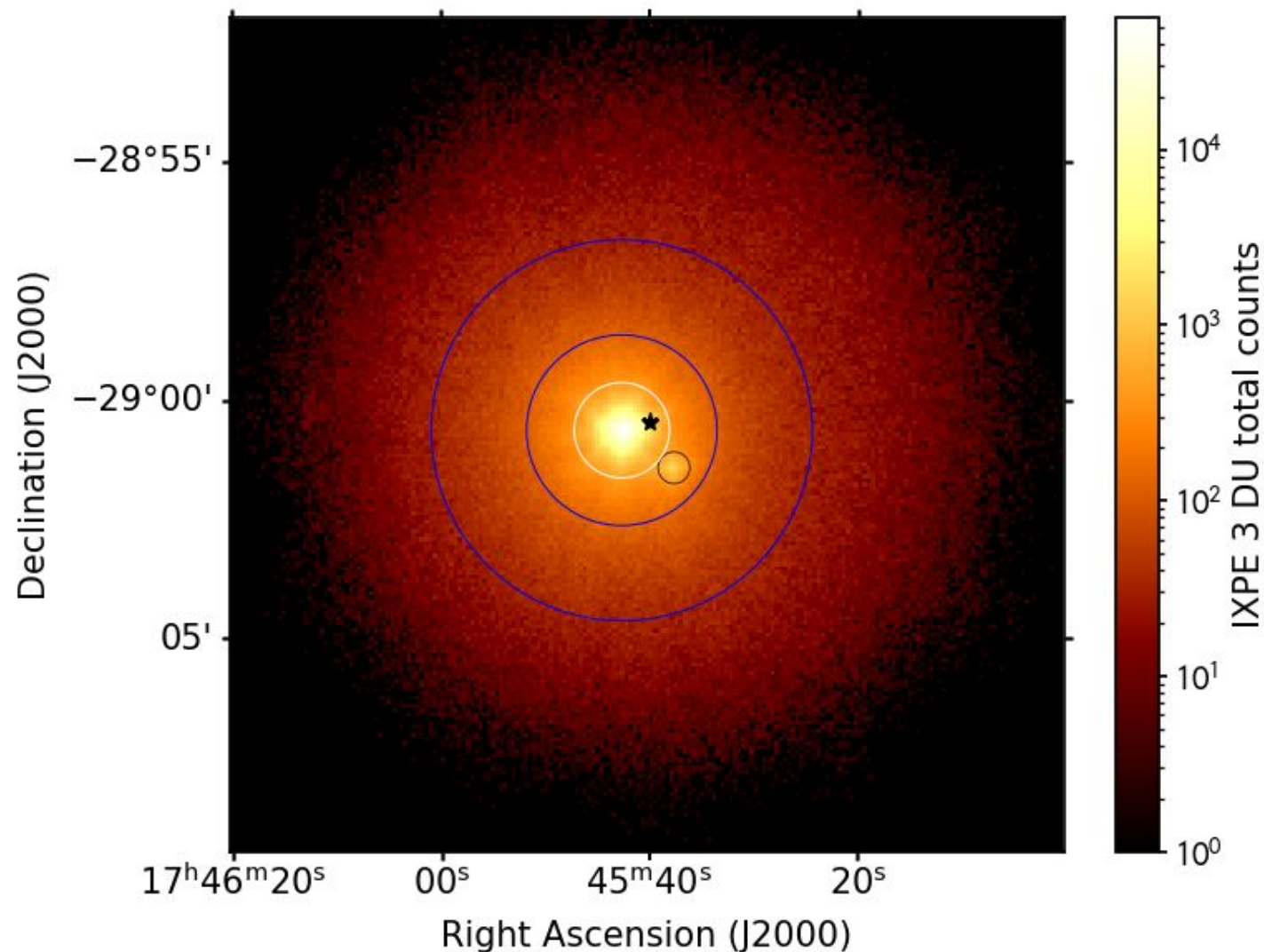
Neutron Star X-ray Binary System Structure



Neutron Star X-ray Binary System Structure



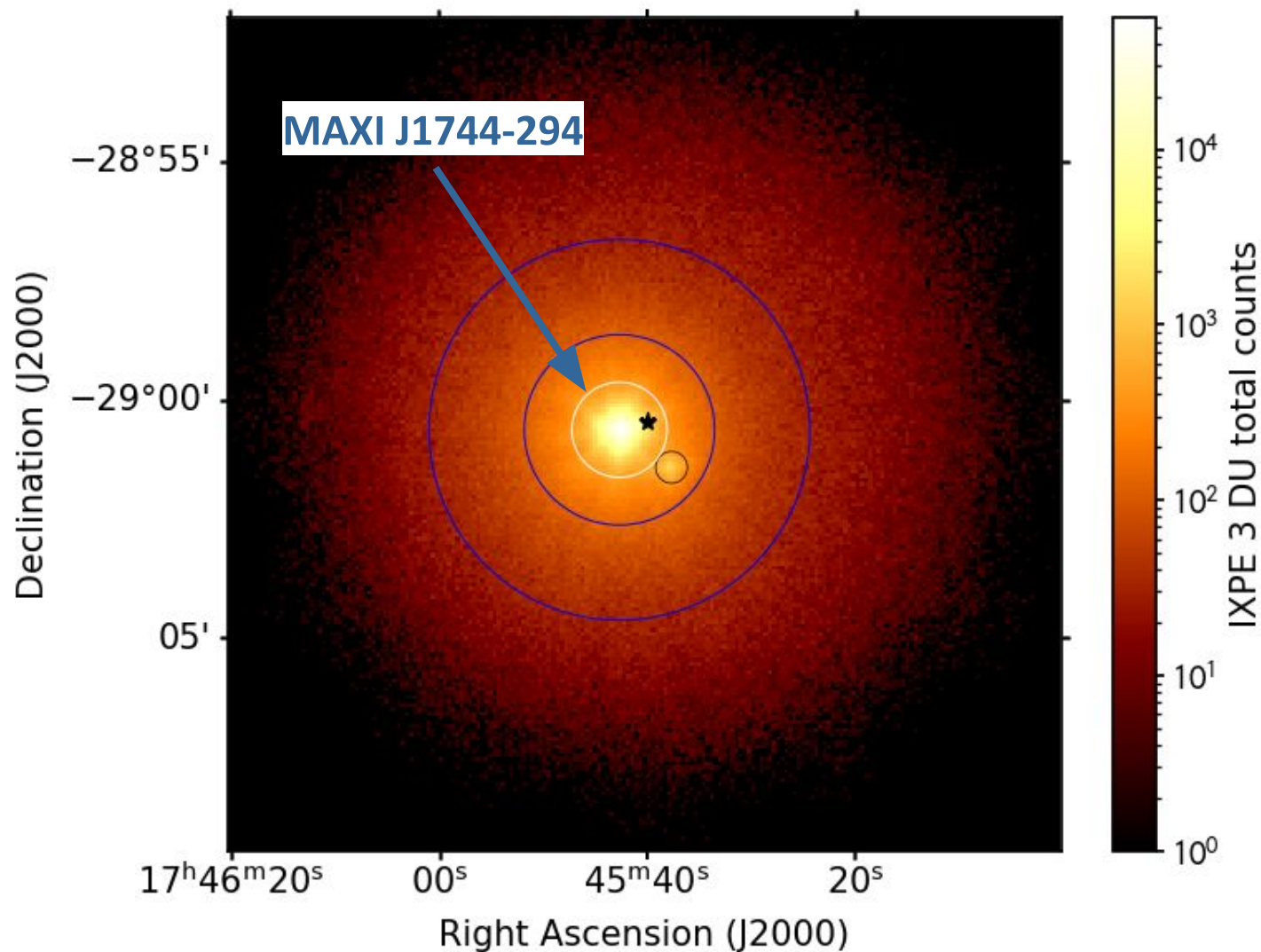
Observation



DDT in April 2025 targeting a BH XRB transient system MAXI 1744-294 with a total of 150 ks with IXPE

- Located in the Galactic center region

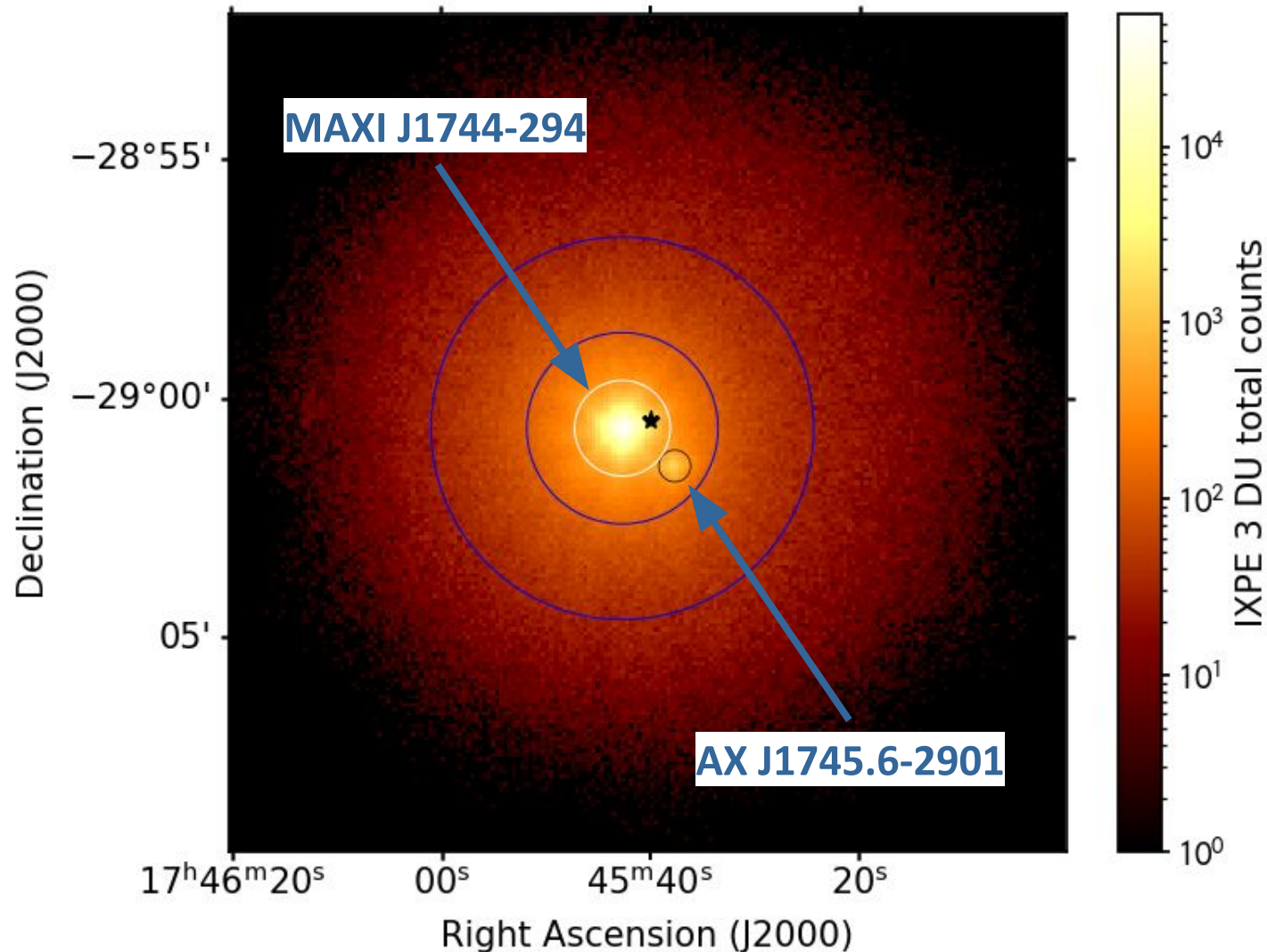
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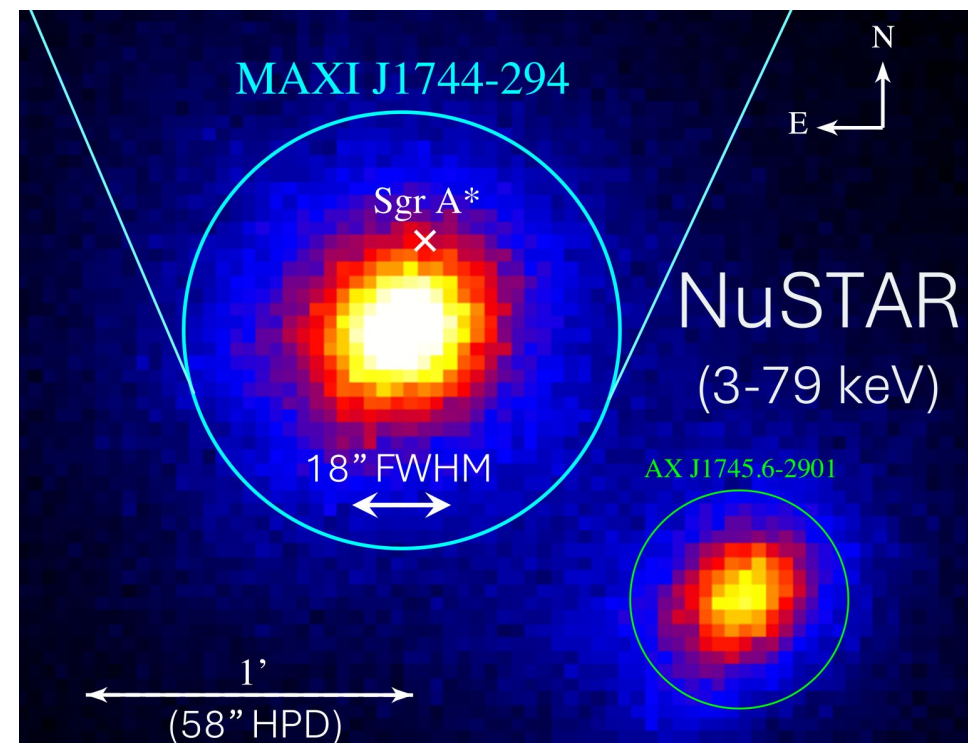


DDT in April 2025 targeting a BH XRB transient system MAXI 1744-294 with a total of 150 ks with IXPE

- Located in the Galactic center region
- During the observation another source was visible in the FOV: AX J1745.6-2901

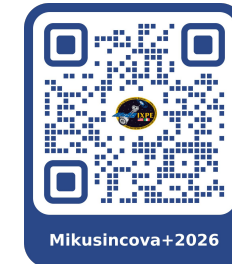
AX J1745.6-2901

- Transient system located $\sim 1.5'$ from Sgr A* and $\sim 1.3'$ from MAXI J1744.294
- NS-LMXB classified as an Atoll source
- In outburst approx. $\frac{1}{3}$ of the time, alternates between hard and soft spectral states
- **Wind signatures** observed in soft spectral state (Ponti+2015, Nielsen & Degenaar+2023)
- Indication of a **nearly edge-on geometry: $i \approx 70^\circ - 80^\circ$** (Ponti+2015, Ponti+2018)
- **Serendipitously observed** during the MAXI J1744-294 pointing by IXPE for a total of 150 ks (DDT) in April 2025, where it appeared as another source in the field of view



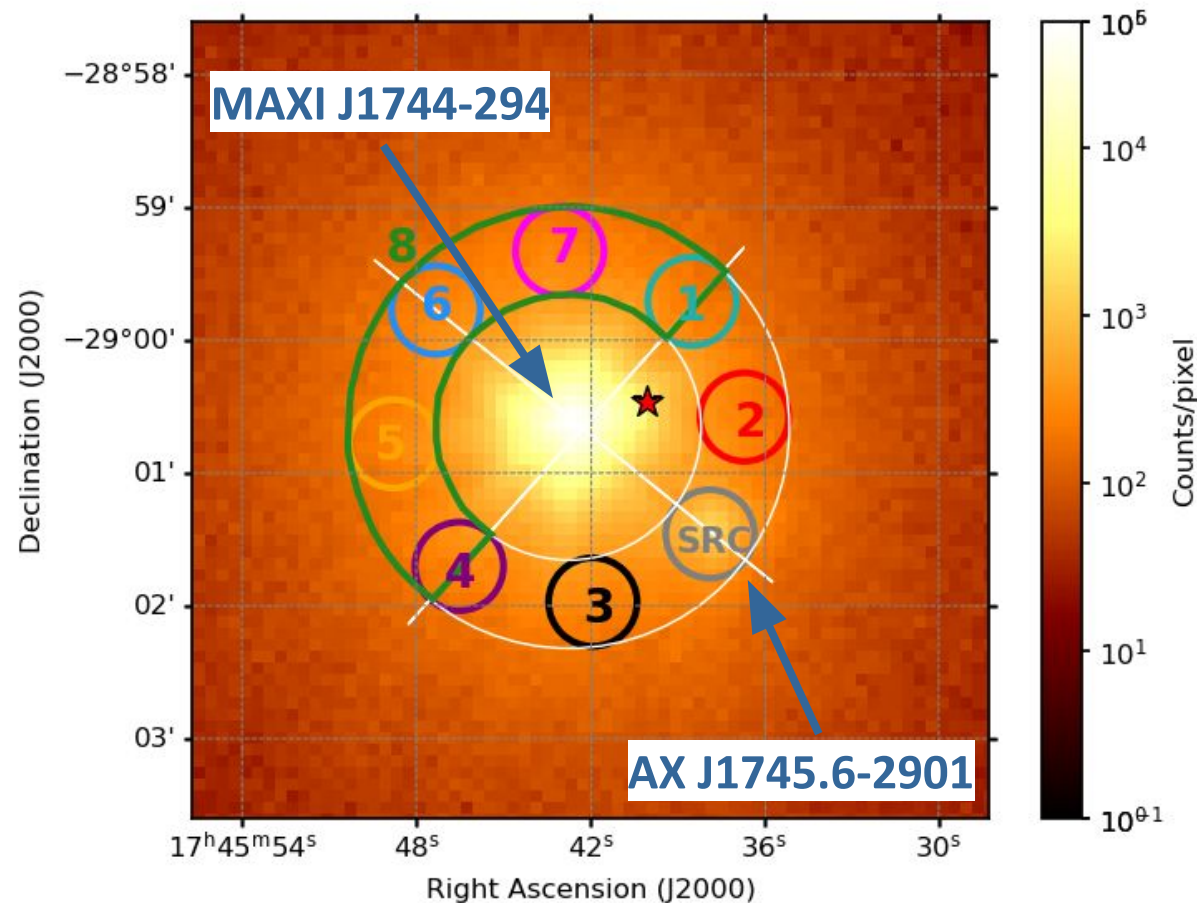
Mandel+submitted

Analysis

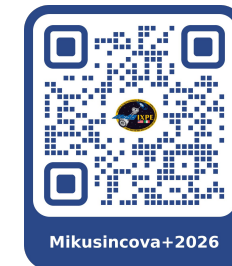


Comprehensive background-subtraction analysis to estimate the source polarization

- BKG regions “1” – “8”
- PD at approx. MDP level when no bkg is subtracted
- PD Likely diluted by unpolarized emission from MAXI 1744

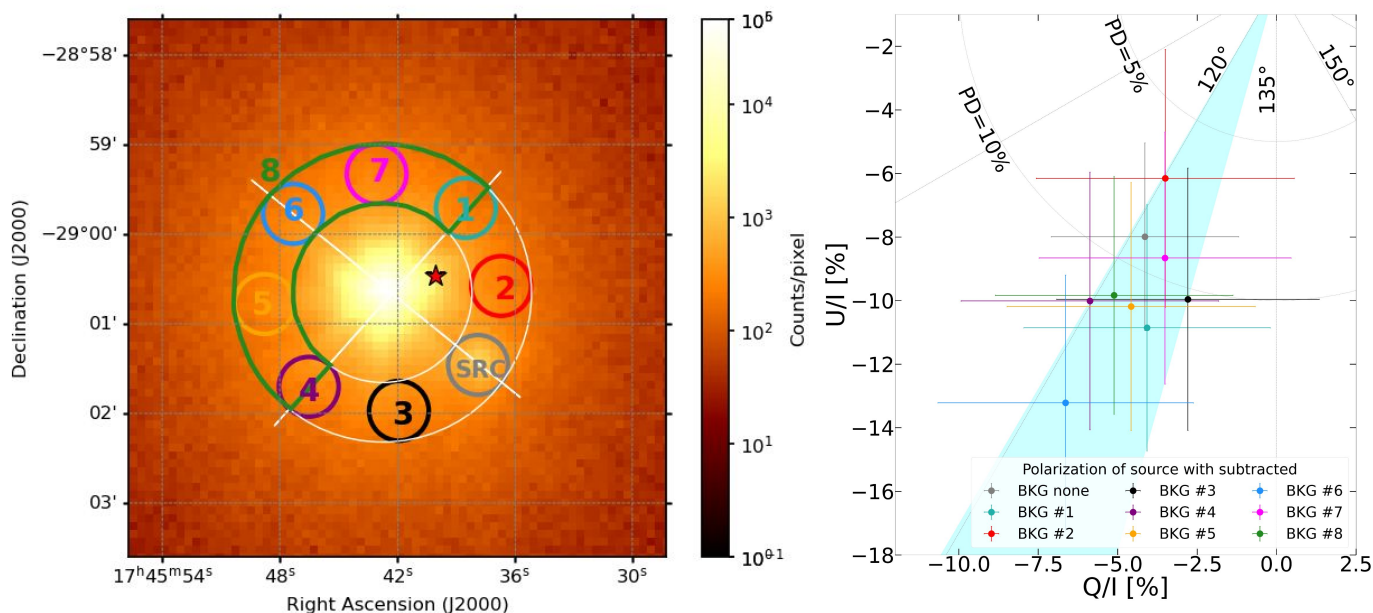


Polarization properties



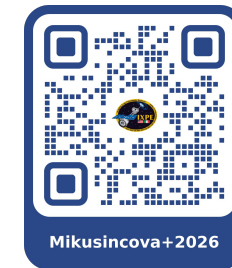
Comprehensive background-subtraction analysis to estimate the source polarization

- PD at approx. MDP level when no bkg is subtracted
- PD Likely diluted by unpolarized emission from MAXI 1744
- Region 6: symmetrically opposite from MAXI 1744
- **Exceptionally high time- and energy-integrated PD (2 - 8 keV): PD = $(14.7 \pm 4.0)\%$ (3.7σ significance in 2 - 8 keV)**
 - **Highest ever measured polarization** in a weakly magnetized NS binary
- **PA = $(122 \pm 8)^\circ$**



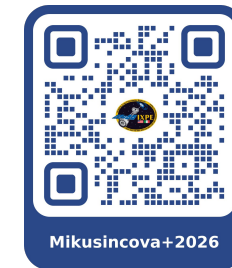
	Subtracted	PD [%]	PA [deg]	MDP [%]
BKG				
none		8.9 ± 2.9	121 ± 9	8.9
1		11.5 ± 3.9	unconstrained (~ 125)	
2		7.0 ± 4.1	unconstrained (~ 120)	
3		10.3 ± 4.1	unconstrained (~ 127)	
4		11.5 ± 4.0	unconstrained (~ 120)	
5		11.2 ± 3.9	unconstrained (~ 123)	
6		14.7 ± 4.0	122 ± 7.8	
7		9.4 ± 4.0	unconstrained (~ 124)	
8		11.1 ± 3.7	121 ± 10	

Phase-resolved Polarimetry



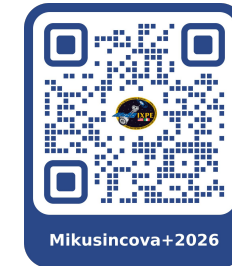
- Source presenting **periodic eclipses** and a complex **dipping behavior**
- Phase-folded analysis of the data from IXPE with a **period of 8.35 hr**
(Ponti+2018)

Phase-resolved Polarimetry

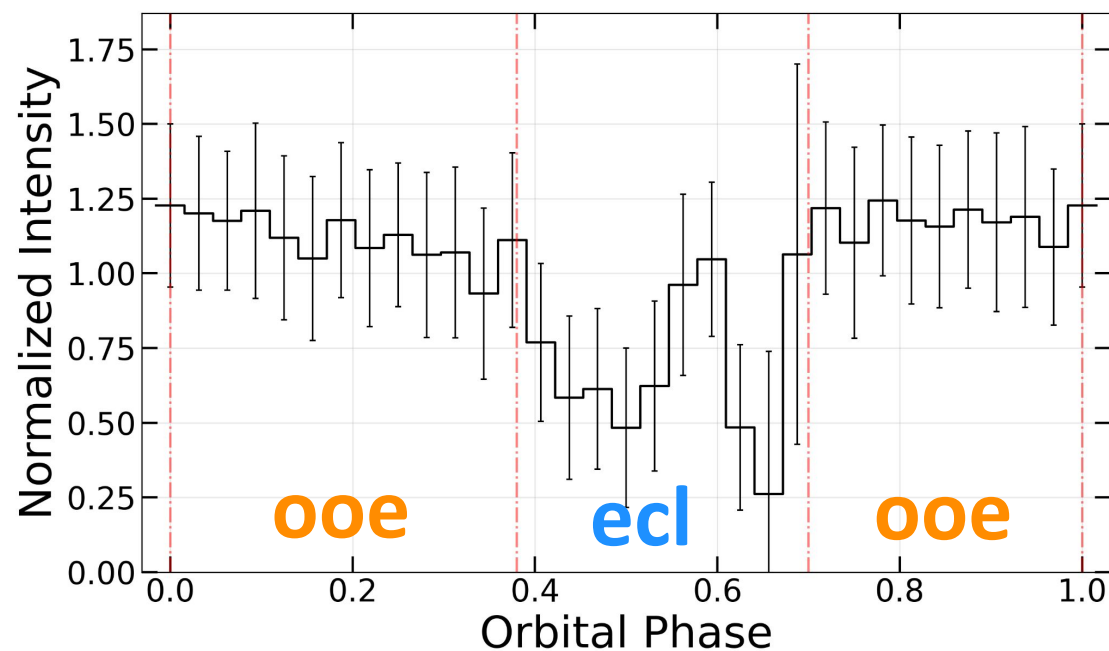


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- Phase-folded analysis of the data from IXPE with a **period of 8.35 hr** (Ponti+2018)
 - Dip+eclipse in the intensity orbital variation

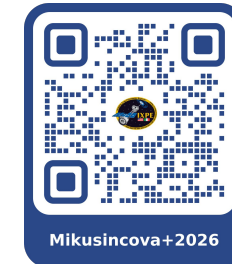
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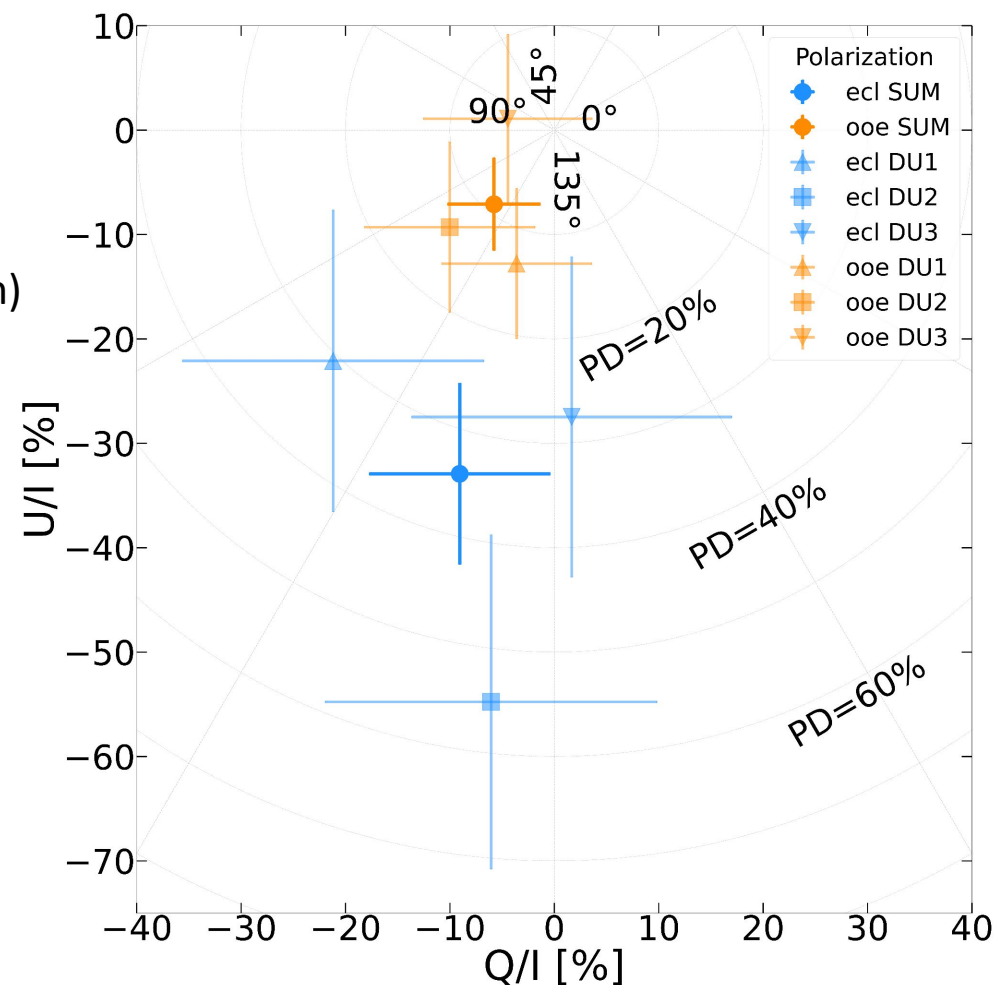
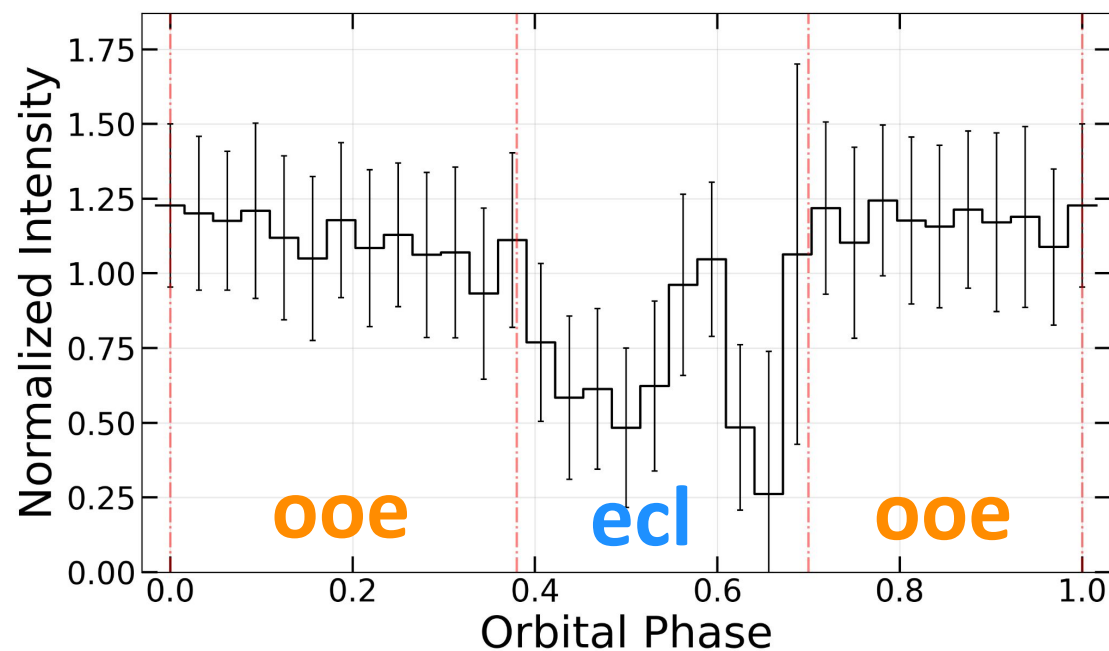
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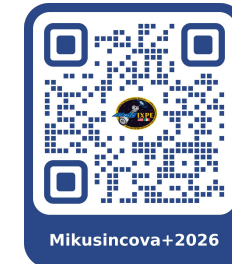
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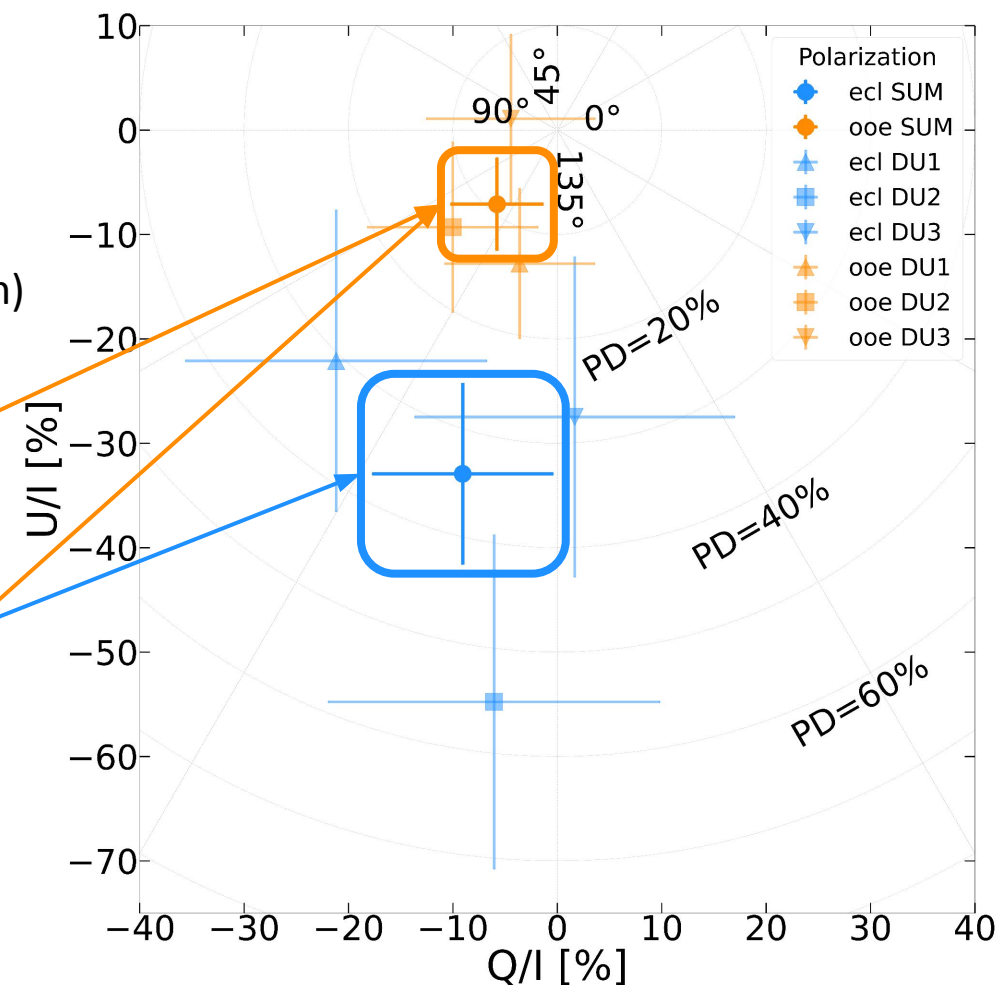
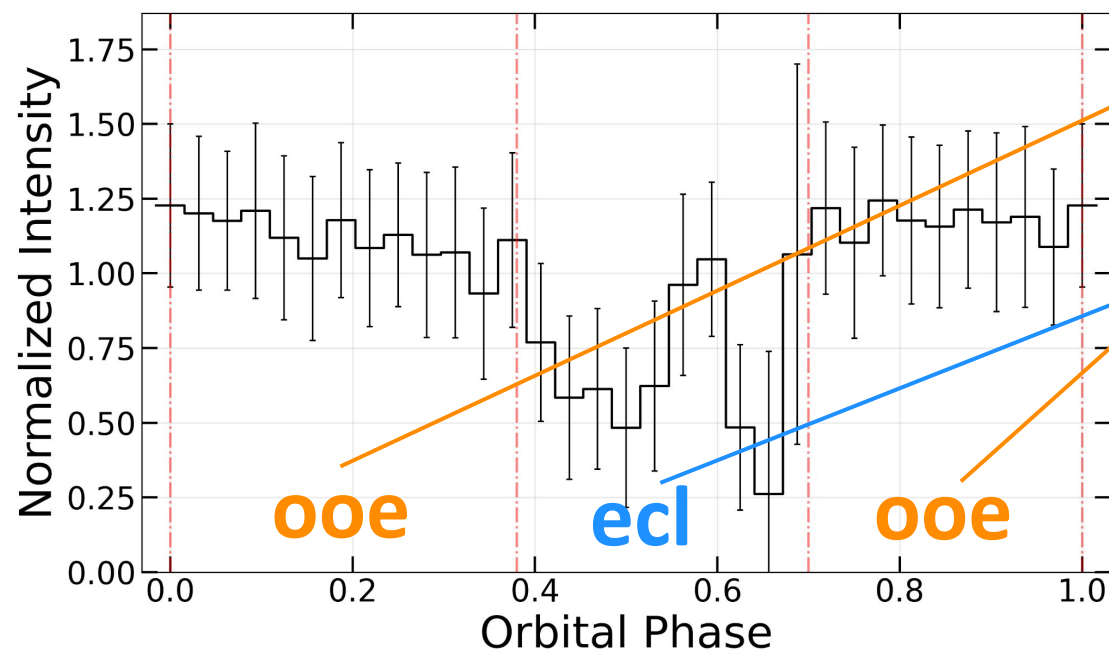
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 - Dip+eclipse in the intensity orbital variation
 - **Dip+eclipse phase: PD = $(34.2 \pm 8.7)\%$** ($\geq 3.9\sigma$ significance)
PA = $(127 \pm 7)^\circ$ - consistent with the phase-average value
 - **Complementary phase: PD < MDP** (no detection of polarization)



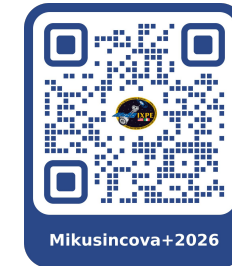
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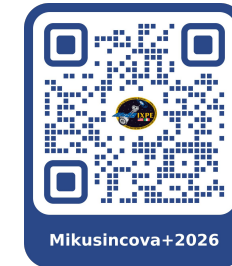


Polarization prediction



- IXPE has measured **PD** ~4 – 6% in Z-sources: GX 5-1 ([Fabiani+2024](#)), Cyg X-2 ([Farinelli+2023](#)), XTE J1701-462 ([Cocchi+2023](#))
 - attributed to the **boundary layer**
- In A-toll sources:
 - GX 9+9 ([Ursini+2023](#)) with **reflection** component at **10 %**, **BL** component at ~**(3±1)%**
 - GS 1820-238 ([Capitanio+2023](#)): upper limit **PD** ~**1.3%**
 - 4U 1820-303 ([Di Marco+2023](#)): reflection component polarized at **5.3%**
- ADC source 4U 1822-37 ([Anitra+2026](#)):
 - **PD = 7.9 %** & increasing with energy (PD = 11% ± 4.0% in 7-8 keV)
 - during eclipse **PD** decreases to **(5.5 ± 1.7) %**
- ADC source 2S 0921-630 ([Tomaru+2026](#))
 - **PD = (8.5 ± 1.6) %** (integrated)
 - **PD = (15 ± 3) %** during eclipse
- Sources with winds
 - 4U 1630-47 ([Ratheesh+2024](#)): **PD** rising from **6 %** (@ 2keV) to **10 %** (@ 8 keV)
 - IGR J17091-3624 ([Ewing+2025](#)): **PD = (9.1 ± 1.6) %**
 - measured polarization was higher than expected and difficult to explain

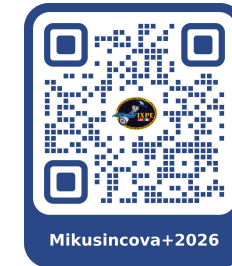
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See talk by
A. Anitra

Summary



- AX J1745.6-2901 was serendipitously observed in April 2025 for 150 ks with IXPE
- The source shows evidence for X-ray polarization with **PD = $14.7\% \pm 4.0\%$** and **PA = $122^\circ \pm 8^\circ$**
- Measured PD = $14.7\% \pm 4.0\%$ is **exceptionally high for NS-LMXBs**, making AXJ the most polarized NS LMXB observed to date
 - models including BL emission / wind signatures typically yield PD < 10 %
 - high PD consistent with **wind signatures** in the source ([Ponti+2018](#), [Matsunaga+2026](#)) contributing to scattering processes
- **Phase-resolved analysis:** PD rises in the **dip+eclipse phase ($34.2\% \pm 8.7\%$)**, complementary phases unpolarized
 - Such a high value of PD during the eclipse and dip phase strongly suggests that **emission is polarized in the disk wind via scattering mechanisms**

.thank you



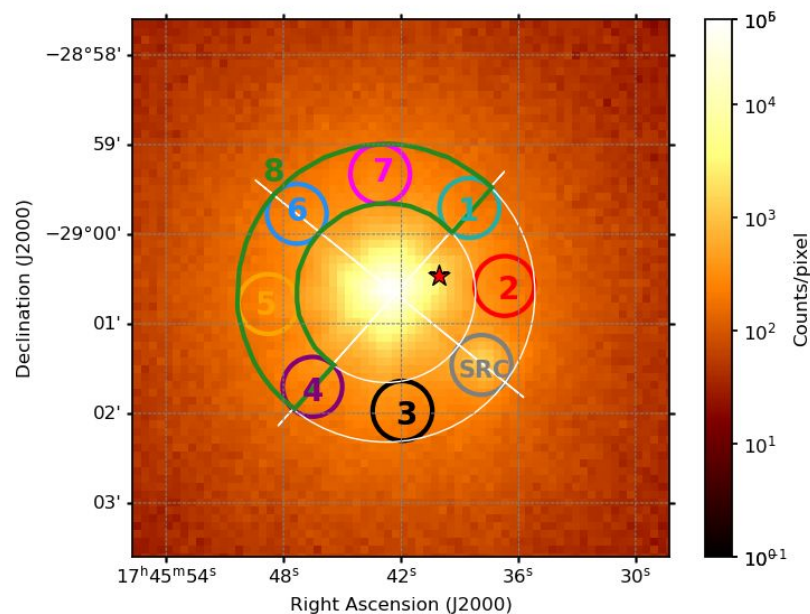
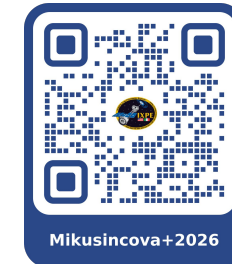
Do you have comments or compliments?



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Backup slides

Analysis of the background



Studied BKG	PD [%]	PA [deg]	MDP [%]
none	-	-	-
1	6.0 ± 5.5	unconstrained (~ 69)	16.7
2	15.8 ± 5.2	123 ± 9	15.7
3	8.7 ± 4.9	unconstrained (~ 95)	14.9
4	2.1 ± 4.9	unconstrained (~ 167)	14.9
5	2.5 ± 5.1	unconstrained (~ 81)	15.6
6	12.7 ± 5.5	unconstrained (~ 33)	16.6
7	8.5 ± 5.1	unconstrained (~ 110)	15.5
8	0.7 ± 1.8	unconstrained (~ 124)	5.5

